

1 CLAIMS

What is claimed is:

Sub A.

1 1. A probe apparatus, comprising:
2 a first positioning unit configured to be optionally added onto a probe
3 station platform;
4 a probe arm attached to the first positioning unit;
5 a second positioning unit attached to the probe arm;
6 a cantilever attached to the second positioning unit, the cantilever having a
7 tip, the first and second positioning units configured to position the tip over a
8 device under test (DUT), the probe apparatus including an electrical signal path
9 between the tip of cantilever and probe station user instruments; and
10 a motion sensor configured to detect motion of the cantilever.

1 2. The probe apparatus of claim 1 wherein the cantilever is micro-
2 machined.

1 3. The probe apparatus of claim 1 wherein the first positioning unit
2 comprises mechanical screws.

1 4. The probe apparatus of claim 1 wherein the second positioning unit
2 comprises piezoelectric elements.

1 5. The probe apparatus of claim 1 wherein the second positioning unit
2 comprises voice coil positioners.

1 6. The probe apparatus of claim 1 wherein motion of the cantilever is used
2 to obtain an image of a surface of the DUT.

1 7. The probe apparatus of claim 6 wherein non-contact forces between the
2 cantilever and the DUT are measured to obtain the image.

1 8. The probe apparatus of claim 1 wherein motion of the cantilever is used
2 to detect a signal in an electrical trace of the DUT.

1 9. The probe apparatus of claim 1 wherein the cantilever is used to supply
2 a signal to an electrical trace of the DUT from the probe station user instruments.

1 10. The probe apparatus of claim 1 further comprising a buffer amplifier
2 included in the electrical path from the tip the cantilever.

1 11. The probe apparatus of claim 10 wherein the cantilever is attached to
2 a support structure attached to the second positioning unit, wherein the buffer
3 amplifier is mounted on the on the support structure.

1 12. The probe apparatus of claim 10 wherein the buffer amplifier
2 comprises a field effect transistor (FET) input buffer in relatively close proximity
3 to the cantilever.

1 13. The probe apparatus of claim 1 further comprising a series resistor
2 included in the electrical path from the tip the cantilever.

1 14. The probe apparatus of claim 13 wherein the cantilever is attached to
2 a support structure attached to the second positioning unit, wherein the series
3 resistor is mounted on the on the support structure.

1 15. The probe apparatus of claim 1 wherein the motion sensor utilizes a
2 light bounce technique to detect motion of the cantilever.

1 16. The probe apparatus of claim 15 further comprising a mirror optically
2 coupled between the cantilever and the motion sensor.

1 17. The probe apparatus of claim 16 wherein the mirror is positioned so as
2 not to interfere with an optical path of an optical imaging system positioned to
3 optically view the DUT.

1 18. The probe apparatus of claim 1 wherein the motion sensor senses
2 optical interference of a light beam deflected off the cantilever with a reference
3 light beam to detect motion of the cantilever.

1 19. The probe apparatus of claim 1 wherein the motion sensor senses a
2 change in resistance of a resistor in the cantilever to detect motion of the
3 cantilever.

1 20. The probe apparatus of claim 1 wherein the motion sensor senses a
2 change in capacitance between the cantilever and an electrode positioned near the
3 cantilever to detect motion of the cantilever.

1 21. The probe apparatus of claim 1 wherein the cantilever comprises a
2 solid conductor.

1 22. The probe apparatus of claim 1 wherein the cantilever comprises a
2 conducting material on another material.

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1 ~~23. A method for probing a device under test (DUT), comprising:~~
2 ~~optionally adding a probe apparatus to a probe station platform;~~
3 ~~coarsely positioning with a first positioning unit of the probe apparatus a~~
4 ~~tip of a cantilever of the probe apparatus over a surface of the DUT;~~

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5 finely positioning with a second positioning unit attached to the first
6 positioning unit the tip of the cantilever of the probe apparatus over the surface of
7 the DUT; and
8 sensing motion of the cantilever.

1 24. The method for probing the DUT of claim 23 further comprising
2 obtaining an image of the surface of the DUT.

1 25. The method for probing the DUT of claim 23 further comprising
2 obtaining a signal in an electrical trace of the DUT.

1 26. The method for probing the DUT of claim 25 further comprising
2 buffering the signal in the electrical trace of the DUT with a buffer amplifier
3 included an electrical path from the tip of the cantilever relatively close to the tip
4 of the cantilever.

1 27. The method of probing the DUT of claim 23 wherein sensing motion
2 of the cantilever comprises:
3 reflecting light from the cantilever; and
4 detecting a change in an angle at which the light reflected from the
5 cantilever.

1 28. The method of probing the DUT of claim 23 wherein sensing motion
2 of the cantilever comprises detecting a change in a resistance of the cantilever
3 responsive to a bending of the cantilever.

1 29. The method of probing the DUT of claim 23 wherein sensing motion
2 of the cantilever comprises detecting a change in a capacitance between the
3 cantilever and an electrode in close proximity to the cantilever, the change in the
4 capacitance responsive to a bending of the cantilever.

Sub 13

1 ~~30.~~ A probe apparatus, comprising:
2 ~~first positioning means for coarse positioning configured to be optionally~~
3 ~~added onto a probe station platform;~~
4 ~~a probe arm attached to the coarse positioning means;~~
5 ~~second positioning means for fine positioning attached to the probe arm;~~
6 ~~a cantilever attached to the second positioning unit, the cantilever having a~~
7 ~~tip, the first and second positioning units configured to position the tip over a~~
8 ~~device under test (DUT), the probe apparatus including an electrical signal path~~
9 ~~between the tip of cantilever and probe station user instruments; and~~
10 ~~motion sensor means configured to detect motion of the cantilever.~~

1 31. The probe apparatus of claim 30 wherein the electrical signal path
2 includes buffer means relatively close to the tip of the cantilever for buffering an
3 electrical signal from tip of the cantilever.

1 32. The probe apparatus of claim 30 wherein the electrical signal path
2 includes resistive means relatively close to the tip of the cantilever for reducing a
3 load on the DUT resulting from the cantilever.

1 33. The probe apparatus of claim 30 wherein the motion sensor means
2 includes reflecting means for reflecting light reflected from the cantilever.